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EDITORIAL

SCIENCE AND PRACTICE

In the world of science the successful resolution of one problem invariably draws attention to another.

This intriguing situation serves as a stimulus to further effort throughout a keen research worker's life. There is always something round the corner and nothing can be final whilst there are new fields and problems to explore.

Life can become a consecutive series of thrilling adventures and there is always the hope that these may bring fame and renown. Those who seek to disclose the secrets of nature experience these thrills to a great degree and particularly so do those who devote their attention to the study of structure and function and the cure and prevention of disease in plants and animals. A constant flow of new information has been available for a long time and is added to each year. The natural history of many diseases and anatomical and physiological abnormalities has been made clear. In consequence the power to make a correct diagnosis has been enhanced and the cause of these aberrations can be determined with accuracy quite often. To be able to make an accurate diagnosis is an essential factor in the fight against disease, but it can be of academic interest only unless one can suggest and adopt some line of therapy which will give a reasonable hope of resolving or mitigating the effects of the disease or defect.

Great advances have been made in therapeutic research in recent years. Precision has replaced conjecture and wishful thinking. The greatest progress has been made in the realms of chemotherapy and in the elaboration of specific

(*The July issue of The British Veterinary Journal was published on July* 18)

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biological antigens. Much information relating to the nutritional requirements and metabolism of the animal body has been disclosed. Knowledge regarding the structure and function of the endocrine system has accumulated and in some measure it has surpassed that of other fields. The font of knowledge has been flowing steadily for centuries but until recent times the workers had fain to " work in the dark " because of the serious lack of fundamental information. Their methods were constrained to be empirical and fraught with the hazards associated with any system of trial and error. In spite of this, many great discoveries were made.

John Woodall and James Lind found a cure and preventative for scurvy. They could have possessed no knowledge of essential food factors yet it is recorded that they were the first to make use of vitamins in the treatment of a disease. Cinchona was introduced to Europe from Peru by Gomez and the Countess of Cinchon. It revolutionised the treatment of ague and malarial fevers. Gomez and the Countess could have known nothing of any parasite in the blood.

The germ theory was not conceived when John Snow's suggestion, " that the handle of the communal pump in Broad Street, London, be removed," was adopted. As a result a cholera epidemic was arrested and Snow's perspicacity made an indelible mark in the history of preventive medicine and sanitary science. The present century has presented a rich galaxy of discoveries resulting from scientific academic research. Names like those of Hopkins, Fleming, Barcroft and Hammond come to mind but there are many more.

As a direct result of scientific research we can cause a calf to flourish or wither and die, we can make a cow into a milk factory, we can cause animals to breed when nature says they should not, we can thwart the germs that invade them with malignant intent and we can keep them alive when by all rules they should be dead.

All this new and startling knowledge has been seized upon by the practising surgeons whose reputation and livelihood depend in great measure upon immediate results which will satisfy the sentimental and economic demands of their clients.

Many animals are restored to health and competence. There are many which are kept alive and it were better that they were dead. The survival of the weak, the diseased, and those subject to anatomical and physiological defects of structure or function, often means that they live on to transmit their defects to their progeny.

Consider fertility. During the last two decades the sum of knowledge relating to the various facets and factors which have a bearing on fertility has advanced by leaps and bounds, and thousands of cows who had little hope of propagating the species have been cajoled into producing calves which may pass on the defects of their dams.

Is this one explanation of the curious fact that in spite of the increase in knowledge, the incidence of infertility is as great as ever?

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GENERAL ARTICLES

EXPERIMENTAL BRONCHOGRAPHY OF THE DOG

By K. M. DYCE

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In the course of a study of the radiological anatomy of the dog, it was thought that the thoracic organs, and in particular the lungs, might be depicted with greater precision and exactitude if use were made of contrast media. In plain films (e.g., Fig. 1) much of the structure of these organs can be recognised but though the larger vessels produce prominent shadows, nothing can be seen of the bronchial tree. It was decided to supplement the plain radiographs by bronchograms—that is, films obtained after outlining the bronchial tree by some suitable contrast agent. An account of the technique for this procedure could not be found in the veterinary literature and in this paper the steps that were taken to devise a satisfactory routine are described.

In human medicine bronchography is an established procedure and is used frequently in the diagnosis of thoracic ailments. Introduced to clinical practice by Sicard and Forestier, in 1922, and since subjected to continual improvements and refinements, it is employed in the diagnosis of bronchiectasis, tuberculosis, neoplasms and many other pulmonary and thoracic affections, and is valuable not only in the initial recognition of the disease but also for the precise localisation of the lesions in anticipation of surgical interference and also in the periodic recording of their progress. So varied and rich a use is not to be anticipated in animals, but there are occasions when this aid to diagnosis could be extremely useful, and it is hoped that this brief note will draw the attention of veterinary clinicians to a valuable aid to the diagnosis of some thoracic lesions.

It might be noted in passing that much of the experimental work preparatory to the medical use of this technique has been conducted on dogs and that these animals were the subjects of the first tentative investigation of Waters and his co-workers in 1917.

Material and Methods

The animals used in this investigation were all adult greyhounds, of both sexes and free from systemic disease. In the great majority of cases one lung only was examined and altogether 42 examinations were made, using 28 dogs. A number of animals were examined on several occasions.

Several contrast agents were employed, but only one was found to be satisfactory and only with this material was there any extensive trial.

In the initial experiments a preparation of iodised oil was used: this agent is the classic choice for human bronchography, but in the dog, in our hands, it proved to be unsatisfactory because it penetrated the finer respiratory passages so quickly that it was impossible to fill all the lobes of the lung before the onset

of alveolar flooding, with consequent loss of pattern. This occurrence is shown in radiograph two. Alveolar flooding occurred when both the standard preparation and the esterised version were used, but, although no effort has been made to check the validity of the suggestion, it is possible that with later improvements in the technique of administration less difficulty on this account would be experienced. These preparations have the further disadvantage that their removal from the lungs is slow and sufficient remains for considerable periods to produce a mottling of the lung shadow that makes subsequent examinations difficult and uncertain of interpretation.

It was partly to overcome this latter difficulty that Tomich *et al* (1953) developed propyliodone as an alternative bronchographic agent. Propyliodone is now available in two preparations—in aqueous and oily base: both are used extensively in human bronchography. Trials with the oily preparation were disappointing for this product seemed to have a disadvantage directly opposite to that possessed by the iodised oils—dispersal beyond the site of injection or of deposition was so slow that even after a period of half an hour only a small portion of the bronchial system was outlined and on one of the few occasions when the agent was injected percutaneously into the trachea, the flow appeared to be against gravity and towards the larynx. It is understood that this difficulty does not arise in the human subject and the suggestion—entirely speculative—is advanced that it is associated with an especially lively activity of the respiratory mucosa of the dog. We did not use this agent after the initial unsatisfactory experiences. A typical appearance of sluggish flow is shown in radiograph three.

In all the later trials the aqueous preparation of propyliodone has been employed and it has given satisfaction as it flows freely into the larger passages and does not reach the alveoli in an unreasonably short time. This agent has the advantage of being rapidly eliminated from the lungs and in most cases it appears to be absorbed completely within three days of bronchography. This is in agreement with results obtained in rabbits and reports of clinical experience in man (Tomich *et al*, 1953). Metabolism studies have not as yet been made in the dog, but there is no reason to doubt that the urinary excretion recorded by these workers in the other species takes place in the dog also. Another agreeable feature has been the complete absence of any toxic effect in all the dogs examined, although in some animals there have been three or four examinations, separated from each other by intervals of only a few days. Details of the pharmacology of the substance will be found in the aforementioned paper. In upwards of 30 trials with this agent, a technique has been evolved that now gives satisfactory radiographs in most examinations, although absolutely uniform and complete filling is not always obtained. The results, however, have improved progressively and it is probable that with further experience full success would be obtained almost invariably. Radiograph 4 portrays an enlarged section of a well-filled lung and shows the excellent representation of the bronchi that is secured.

From the radiographical point of view, the demonstration of the lungs of the dog is complicated by the restricted diameter of the thorax and by the

PLATE 1

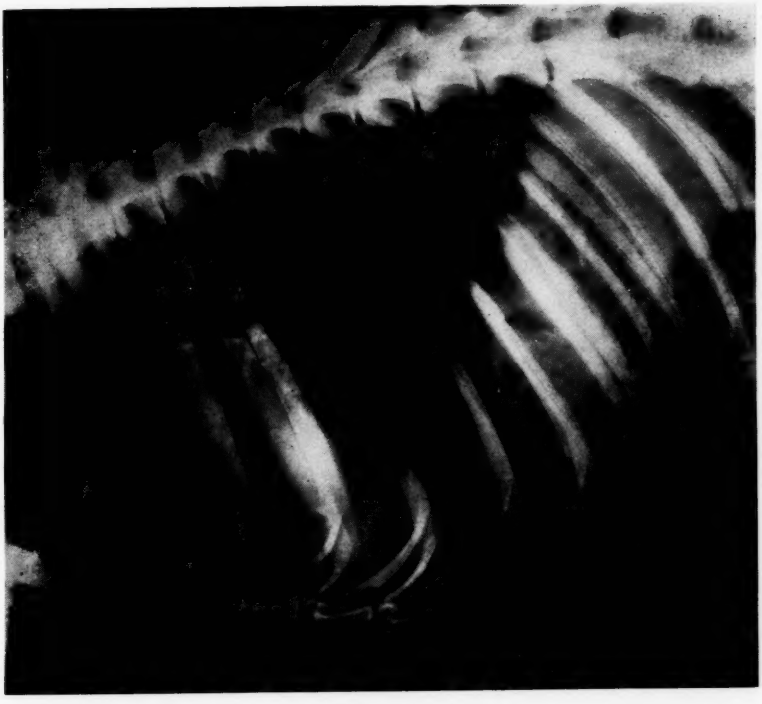

Fig. 1
A plain film of the chest.

Fig. 2
Alveolar flooding with iodised oil.

Fig. 3
Failure to disperse propyliodone in oily base.

(*Article by Dyce, page* 319)

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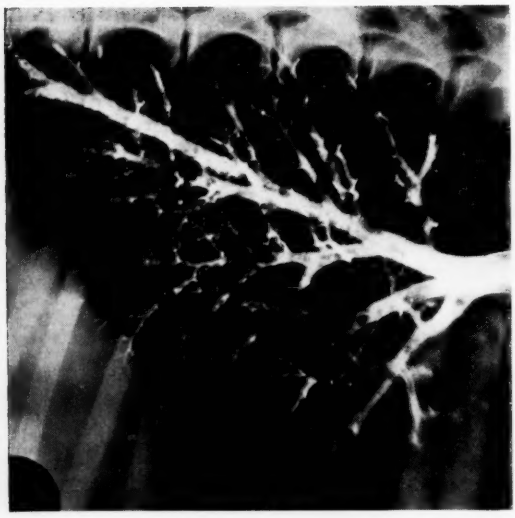

Fig. 4
Propyliodone in aqueous base. An example of fine pattern.

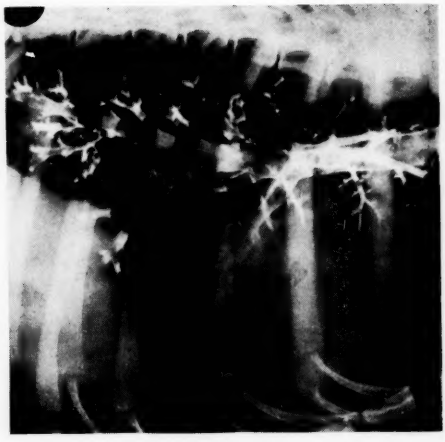

Fig. 5
A coarser pattern.

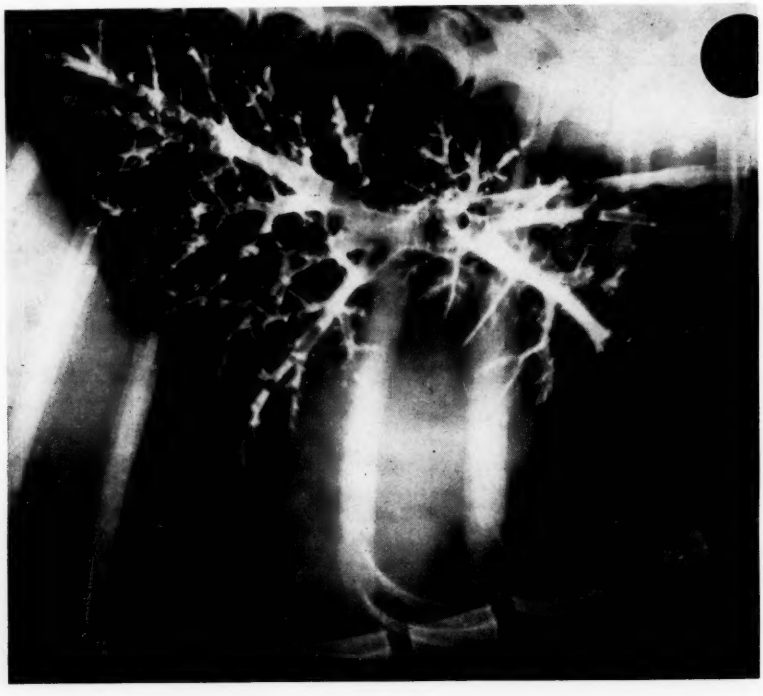

Fig. 6
Lateral view of the bronchial tree of the right lung.
(*Article by Dyce, page* 319)

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disproportionate breadth of the heart, as compared with that of man: further, the pronounced anterior convexity of the diaphragm and the relatively thick dorsal musculature combine to make it almost impossible to secure a clear dorso ventral radiograph of much of the pulmonary fields. While dorso ventral radiographs tend to be of little assistance, the alternative projections in other planes suffer from the disadvantage that the two lungs are projected one upon the other. For this reason it is preferable to fill only one lung at a session, and when both lungs are to be examined two investigations should be made, with an interval of several days, in order to allow for absorption.

This apart, the radiographic aspects of bronchography require little comment. Views in the lateral and oblique positions should be obtained: for the latter the subject is placed on its back and then rotated some thirty or forty degrees towards the side under investigation.

The prime need in lung radiography is for a short exposure that will minimise so far as possible the blurring effect of the heart movements. Fast film with screens should be used. A grid is neither necessary nor advisable—scatter is slight and the increase in exposure time undesirable.

Recommended Technique

In recommending the following technique it is not suggested that it is necessarily final nor that it cannot be improved. It has, however, been evolved after considerable experiment and if it is given in rather tedious detail this is because of the need for care in the procedure if all parts of the lung are to be filled.

The choice of the route of administration of the agent that confronts the medical radiologist does not arise when working with animals: it is obviously impossible to introduce a fluid into the respiratory passages of the unanæsthetised dog without provoking struggling and distress, and a general anæsthetic is therefore essential in every case. This is not a disadvantage since it simplifies the positioning of the animal during the filling of the lungs and subsequently for radiography. The procedure is as follows. The animal is anæsthetised with a short acting barbiturate, and a polythene tube, stiffened by the insertion of a wire, is passed through the mouth and, after depression of the epiglottis, into the larynx and thence into the trachea: the stilette is withdrawn and a needle of appropriate size is attached to the catheter: to this a hypodermic syringe containing the agent is fitted and the catheter is filled (the capacity of the tube being known). The tube is now passed to a point immediately above the bifurcation of the trachea or just into the main bronchus of the lung: this position can be checked on the screen and any necessary adjustments made. If facilities for screening are not available the correct position must be estimated, and in such circumstances one should take care to err on the side of insufficient introduction of the catheter.

The animal is then removed from the table and supported in the sitting position by an assistant. For the injection the dog is first inclined backwards and

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towards the side to be examined: the first quantity is injected and the position maintained for some 30 seconds to allow time for the fluid to pass into the upper portion of the diaphragmatic lobe—the most dependant part of the lung at this stage. The dog is then inclined forward and again to the side: the second injection is made and there is a pause whilst the remainder of the diaphragmatic lobe (and in the case of the right side, the intermediate lobe) is filled. Next the animal is laid horizontally with the side to be examined downwards: the third injection is made and a further delay follows while the cardiac lobe is filled. Before the final injection the hindquarters are raised to permit filling of the apical part of the lung: after this is completed the animal is rolled first on its back, then upon its breast, in an effort to secure complete distribution of the medium within the bronchial tree. The catheter is now withdrawn. The quantities used are 5, 4, 3 and 3 c.c., a total of 15 c.c., for greyhounds of approximately 65 lb. body weight.

The two exposures—lateral and oblique—may be made immediately, but if safe conditions for screening exist a preliminary scanning is useful and allows small additional quantities to be administered when necessary: in these circumstances the catheter would be left in situ until it is ascertained that the distribution is satisfactory.

With greyhounds as the subjects the exposure factors adopted have been, in the lateral position, 56 to 60 kv, 100 ma, 0.5 to 0.6 seconds at 36 in.; in the oblique position, 60 to 65 kv, 100 ma, 0.5 to 0.8 seconds at 36 in. It has been noted previously that the dorsal view is scarcely worth the trouble involved in taking the radiograph.

Discussion

The nature of the radiographs may be studied in the accompanying illustrations. It will be observed that the bronchial tree is depicted clearly in all its complexity.

At this stage it would be premature, if not misleading, to describe at length and in detail the radiological anatomy of the bronchial tree since much more experience, combined with a study of bronchial casts, will be necessary before the normal pattern of arborisation and the nature, extent and frequency of variations can be known.

The more important features, however, are obvious. The trachea of the dog terminates by dividing into two main bronchi—one to each lung—and the main bronchus to the right apical lobe does not, as in certain other animals, arise independently. Posterior to this division the bronchi diverge, that to the left lung being the more sharply deflected from the course of the trachea—thus accounting for the greater difficulty experienced in obtaining satisfactory filling of the left lung. After a short passage each bronchus gives off a branch which passes cranially to supply the apical lobe and behind this and crossing the posterior part of the heart shadow is the single large division to the cardiac lobe.

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Between these two branches there is a large extent of the chest field that is unoccupied by bronchi. Beyond the point of origin of the cardiac bronchus the main stem ends by dividing into a variable number of branches that pass, in a diverging manner, into the large diaphragmatic lobe. An additional feature of the right lung is the azygos or intermediate lobe that lies posterior to the heart: the bronchus to this lobe can be identified as it runs ventrally along the caudal border of the heart (see Fig. 6). The main stem and the major bronchi all give off small trunks that pass upwards to ventilate the most dorsal parts of the several lobes.

Comparison of the illustrations (in particular of radiographs four and five) will show that there is a considerable variation in the general appearance of the bronchial tree: the pattern in some animals is fine and slender, while in others it is characterised by a stubbier and courser arborisation—as in Fig. 5 (in which only the major bronchi are filled).

The lack of a detailed knowledge of the bronchial anatomy need not prevent the clinical use of bronchography of the dog since in veterinary medicine the method must be concerned largely, if not exclusively, with the diagnosis of abnormality or disease of the lung. For this it is sufficient to recognise interruptions, abrupt terminations and distortions of the general pattern with which familiarity is acquired readily: the need for more precise investigation will arise rarely.

Acknowledgment is due to several members of Glaxo Laboratories Ltd. for advice and for the supply of propyliodone (Dionosil) preparations, and to C. Fowler for technical assistance.

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STUDIES ON THE CLIMATE OF PIG HOUSES

I.—The Ventilation of Piggeries

By D. W. B. SAINSBURY, B.Sc., Ph.D., M.R.C.V.S., and
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Of the problems facing the pig farmer at the present time, one of the most important is the difficulty of providing a satisfactory climatic environment in pig houses at all times of the year. Too often piggeries are erected with little or no attention having been given to either their thermal insulation or their ventilation, and consequently it is found that pigs do not thrive in such houses. This sequel is in line with the fact that the pig is physiologically ill-adapted to withstand climatic extremes (Capstick and Wood, 1922; Robinson and Lee, 1941; Newland, McMillen and Reineke, 1952). In Great Britain the complex of climatic factors that appear to be most harmful to pigs is one which is cold, damp, and draughty. Observations which clearly demonstrate this have been made in Northern Ireland by Lamont and his co-workers (Lamont, 1938, 1951; Shanks, 1939 and 1942; Lamont, Luke and Gordon, 1950) and in Scotland by Howie, Biggar, Thomson and Cook (1949), and by Inglis and Robertson (1949, 1951). One principal finding common to all these investigations was that most of the piggeries were extremely badly ventilated, and possibly this was the factor which contributed most to bringing about the unsatisfactory conditions found in so many of them.

Impressed with the apparently over-riding effect of environmental conditions on pig production, but confronted with the lack of any real or measurable data establishing their relation to each other, investigations were begun in 1951 by the Department of Veterinary Hygiene, Royal Veterinary College, which had as their first objective the detailed study in quantitative terms of the indoor climate (micro-climate) of pig houses. A brief account of the methods used has been given by Sainsbury and Dunkin (1953), but a fuller account is being prepared. Of forty-two piggeries in southern or south eastern England which we have investigated, only four were ventilated satisfactorily as judged by a subjective impression of the general atmosphere, by the absence of draughts, by ease of air control to the building, and by the maintenance of suitable air temperature and circulation. In the other thirty-eight, faulty ventilation arising from various sources was the principal cause of the bad climatic conditions prevailing. Ventilators as such were in many instances non-existent, and where they were present they were usually so badly designed, badly constructed and badly sited that their value was nil, or even negative. It seems, therefore, worth while in the first instance to describe some of the faults commonly found in piggery ventilating systems, and then to outline some methods capable of securing a sufficient and controllable air flow without draughts, even under the worst possible external climatic conditions.

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COMMON FAULTS IN VENTILATION SYSTEMS

(a) The Rate of Air Flow

In general, the amount of air passing through almost all the houses was found to be such that it resulted in dissipation of animal heat, creation of draughts and depression of temperature. This observation was true, surprisingly, even for houses having no recognisable ventilators: the reason for the excessive air flow in these cases being the large volume of air entering via adventitious openings, such as ill-fitting doors and windows, drain exits, and broken window panes. This is made clear by the data given in Table I, which represents two simultaneous series of actual measurements of ventilation rate in a number of buildings by (a) direct measurement of air velocities *through ventilators alone* using either anemometers or the kata-thermometer, and (b) the indirect CO_2 estimation method (Haldane and Graham, 1934) whereby the *total quantity of air flowing through the building* in standard time is measured. The discrepancy between the two sets of measurements is considerable. Thus, on the average, only 44 per cent of the ventilation took place through the recognisable ventilators, the remainder taking place through adventitious openings. Air passing through faults in the structure of a building is particularly undesirable, as not only will much of it be near the floor, causing direct draughts on the animals, but will also be uncontrollable, unbaffled, and greatest at those times when it is least necessary, that is, during periods of high wind. In well-built houses virtually all the air flow should and can take place through the ventilators.

TABLE 1. COMPARISON OF VENTILATION RATES CALCULATED BY DIRECT AND INDIRECT METHODS.

Construction of Piggery.	Air changes per hour calculated from estimation of CO_2 (=total ventilation)	Air changes per hour calculated from air velocities through ventilators (=total ventilation less adventitious air flow)
Corrugated Iron and Wood Walls, Corrugated Asbestos Roof.	6	3
Concrete Block Walls, Corrugated Asbestos Roof.	5	3
Stone Walls, Tiled Roof.	10	4
Stone and Brick Walls, Corrugated Asbestos Roof.	7	2
Stone Walls, Corrugated Iron Roof.	5	3
Stone Walls, Corrugated Asbestos Roof.	6	2

(b) The Design and Construction of Ventilators

The design of the ventilators examined in our survey was generally classifiable as bad, by virtue of the fact that they were without baffles or controls and were of uninsulated construction. In the case of the capped open ridge, which is much favoured for outlet ventilation, down-draughts blowing into the building appeared to be unavoidable. Many patterns of patent extractor cowls, in addition to having most of the faults mentioned above, were too small and over-elaborate to work effectively, especially after they had been in use for some time with the inevitable aggregation of dust and dirt reducing their air inflow capacity.

(c) The Siting of Ventilators

Fresh air inlets in the houses investigated were more often than not placed near the floor. This, coupled with an almost universal lack of any baffling, gave rise to undesirable draughts. It was obvious, too, that air outlets were rarely sited to give maximum efficiency, either as regards their location in the pig houses or in relation to the proximity of other farm buildings.

(d) The Pattern of the Air Flow

The motive force of natural ventilation in buildings constructed of poor insulating materials and in which, therefore, inside temperatures approximate to those existing outside is almost wholly derived from the perflating and aspirating effects of wind. Even where the ventilators are adjustable the rate of air flow in the building is obviously at the mercy of fluctuations in the wind's speed and direction—proverbially uncertain factors. Ventilation under these conditions tends to be least when most required, namely, when the weather is warm, calm and humid and, on the other hand, greatest when least required, that is, during

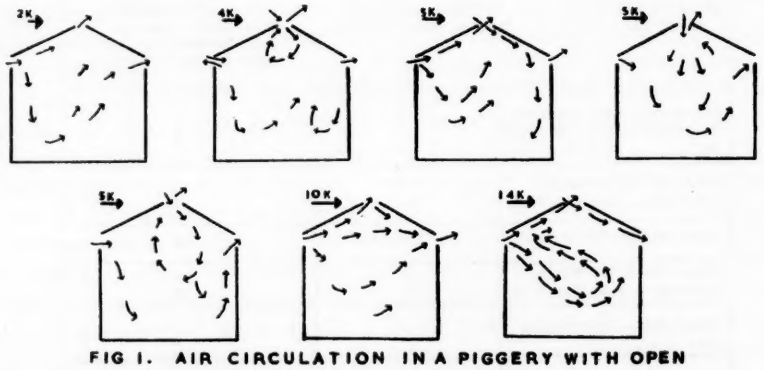

FIG 1. AIR CIRCULATION IN A PIGGERY WITH OPEN EAVES AND RIDGE VENTILATION UNDER DIFFERENT WIND CONDITIONS. NOTE THE FREQUENT OCCURRENCE OF DOWN DRAUGHTS. WINDSPEEDS IN KNOTS (K)

(ORIGINAL DATA)

cold and windy weather. The commonent method of ventilating larger pig houses is a capped open ridge for outlet, and some form of wall or window inlet. The belief that the open ridge acts solely as a stale air extractor is a naïve premise which is rarely true, except perhaps under the conditions of near-calm (see Fig. 1, first diagram). The air currents directed into the house via the open-ridge are

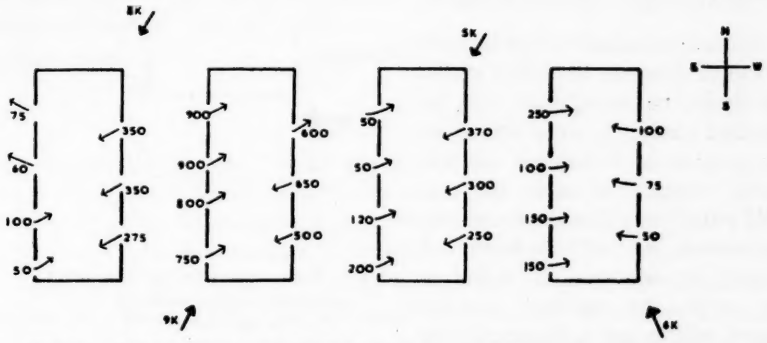

FIG 2 THE COMPLEX PATTERN OF AIR ENTRY AND EXIT THROUGH THE SIDE VENTILATORS OF A PIGGERY AT DIFFERENT WINDSPEEDS IS SHOWN.
WINDSPEED IN KNOTS(K). AIR VELOCITY THROUGH VENTS FT/MIN.
(ORIGINAL DATA)

particularly undesirable, since they are orientated towards the pigs' backs. A second fallacy is the belief that wind tends to blow through ventilators on one side of the building and out through those on the other side. Though this may

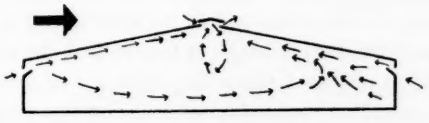

FIG. 3 TURBULENT NATURE OF AIR FLOW IN A WIDE SPAN BUILDING INDUCED BY AIR ENTERING BOTH SIDES AND BY THE OPEN RIDGE (ORIGINAL DATA)

be true for narrow-span buildings, it is more usual in wider buildings for the air to pass in through most of the ventilators on both sides (as seen from actual observations, Figs. 2 and 3). A likely reason for this has been given by Müller (1939) as a result of a study of the flow pattern of air over grounded house

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models (Fig. 4). His work makes it clear that it is possible for the eddies produced at the leeward face of a building to cause air entry on this side. The above considerations obviously suggest that wind is too uncertain a source on which to rely for the supply of motive power to a ventilation system.

THE REQUIREMENTS OF SATISFACTORY VENTILATION

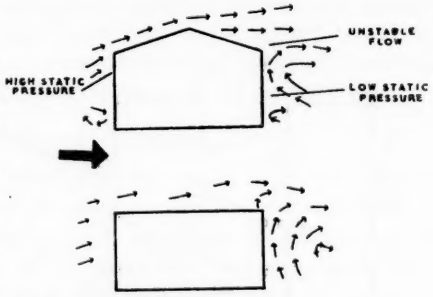


FIG. 4 FLOW PATTERN OF AIR OVER GROUNDED HOUSE MODELS [AFTER MÜLLER 1939]

Natural ventilation must be such that the air flow can be varied within wide limits, be draughtless, and be controlled easily. It must secure an even circulation of fresh air and the efficient removal of stale air, and should reduce to a minimum moisture condensation on cold surfaces. A first-rank consideration is ability to cope with the sudden extreme changes which are a feature of the British climate. For pigs of different weights and ages, different climatic desiderata are postulated, and ventilation should, therefore, be capable of variation to approximate the best conditions of air temperature and humidity obtainable for a particular group of pigs at any given time.

We have already noted that when ventilation depends solely on the aspirating and perflating action of the wind, the result can never be other than extremely uncertain. If, however, the motive power of a ventilating system derives from the mass differential of the warm (expanded) air inside the piggery and the cooler outside air, the ventilation rate is assured of a reasonable constancy. As a consequence of the upward movement of warmed air, the highest level within an animal building is the logical site for air extraction. By the same reasoning, the location of the inlets will be at some lower level, although other considerations preclude the lowest level. It is true that the maximum advantage of the "stack-effect" is obtained when the inlets are at or near floor level, but as far as the pig is concerned physiological and comfort considerations rule out the placing of air inlets anywhere in the lower face of the wall. In any case, as will be shown later, a sufficient "stack-effect" can usually be obtained with the inlets placed at from one to two feet of the wall plate.

The height of the outlet should be not less than six feet above the level of the air inlets. If the air outlet takes the form of an insulated "chimney" or "flue" raised some two feet higher than the ridge of the roof the "stack-effect" is correspondingly augmented. The projection of the chimney well above the ridge will in addition also minimise any tendency to down draught due to the eddying of the wind over and round the roof.

COMPUTATION OF OUTLET VENTILATOR DIMENSIONS

The warmed and, therefore, less dense air round the body of an animal tends to rise to the apex of an open-roofed animal house, and will pass to the exterior if an outlet ventilator is placed there. Colder and denser fresh air then flows in at lower levels and so secures equilibrium of the pressure as between inside and outside atmospheres. The theoretical velocity of air flow through a roof ventilator in the form of a simple chimney or flue is obtained from the following equation (Wooley, 1946):—

$$V = 2880 \sqrt{\frac{H\ (Ti - To)}{To + 460}}$$

where V = Velocity of air flow in feet per hour.
H = Distance between air inlets and outlets in feet.
Ti = Atmospheric temperature inside the building (° F.).
To = Atmospheric temperature outside the building (° F.).

Because of the retarding effect of friction on the air at the surface of the flue, and also due to turbulence and to cooling of the air as it passes upwards in the lumen of the flue, the actual air velocity in the flue is usually considered to be about one half the theoretical value; Wooley (op. cit.) actually puts it as low as 40 per cent. Although our own experience does not indicate the likelihood of a value quite so low as this, in order to ensure conservative design calculation may be based on a 40 per cent efficiency, when the formula will then become:—

$$V = 11520 \sqrt{\frac{H\ (Ti - To)}{To + 460}}$$

When either the intended or the actual difference between inside and outside temperatures is known, and also the height of the outlet above the inlets, the velocity of air flow through the ventilator can, therefore, be computed easily. The dimensions of a flue required to give a definite ventilation rate in standard time can then be calculated, since

Air flow (cu. ft. per hr.) = Velocity of flow (ft. per hr.) × Area of flue (sq. ft.).

The flue must be so designed that (a) it functions satisfactorily without the help of the aspirating force of the wind, although as a rule this will be operating, and (b) it can cope with the most extreme weather conditions.

Example.

To make the method of computation clearer, as well as affording an indication of the size of flue which might be required in a piggery, the resolution of the following problem likely to occur in practice is given as an example.

The average February outside air temperature in Great Britain is known to be 40° F., and a temperature of 60° F. is required inside the piggery, i.e., a temperature differential of 20° F., which should be possible in any well-constructed and well-insulated pig house. Height of the outlet flue is taken at

only 8 feet above the inlets; then inserting the appropriate known values in the formula we get

$$V = 11520 \sqrt{\frac{8\ (60-40)}{500}}$$

$$= 6515 \text{ cu. ft./hour/sq. ft. of flue.}$$

In a completely enclosed house, i.e., without outside runs, one square foot of flue when extracting air at this rate would be sufficient for approximately 10 fattening pigs, allowing 600 cut. ft. per hour per head. A house containing 100 fatteners would, therefore, require a flue having an area of 10 square feet (approximate dimensions $3\frac{1}{4}$ ft. $\times$ $3\frac{1}{4}$ ft.).

If, in the example cited above, the outside temperature should fall below 40° F., then the "stack-effect" would become greater, assuming the temperature inside remains at 60° F. On the other hand, if the outside temperature were to rise, and there was no aspirating effect from wind, supplementary forms of ventilation could be brought safely into use, since above an atmospheric temperature of 40° F. during relatively calm conditions, the liability to draught production would be negligible. One type of ventilator that could be used in these circumstances is a hopper window with side cheeks (or gussets), located high in the wall.

In the course of our own investigations we studied the air flow in several forms of rectangular, insulated flues, particularly in order to verify the claimed 40 to 50 per cent efficiency. Now, days of absolute calm are rare in this country, but on six occasions measurements were made when there was no measurable wind. It was found that efficiency at these times rated at well over 50 per cent and was generally nearer 60 per cent. For comparison, the lowest recorded efficiency was 48 per cent, obtained with an uninsulated flue.

DETAILS OF VENTILATOR CONSTRUCTION

1. An Outlet Ventilator.

As opposed to the fixed and capped open ridge ventilators so commonly seen in Great Britain, American and Scandinavian practice favours a rectangular outlet flue of simple design and easily constructed by unskilled labour (Becker and Korsgaard, 1952; Kalbfleisch and White, 1951). We have found that this appliance functions efficiently in the climate of Southern England. Soutar (1953), who has designed and used a similar type of flue, has also found it satisfactory in Scotland.

The type of chimney flue we advocate is illustrated diagrammatically in Fig. 5. Only one such flue is normally required in a piggery (or self-contained section of a piggery), because if two flues are used there is a tendency for warm air to flow up one of the chimneys whilst cold air passes down the other. The

best position for the chimney is at the roof centre of the building projecting two or three feet above the roof ridge.

The chimney ventilator should always be constructed of wood, thus ensuring good insulation and thereby eliminating any danger of the warm air flowing up the flue being cooled and so, instead of passing to the outlet, being dropped back into the building. A suitable construction is wood sheathing internally, with insulation board covered with some weather-proofed material externally. These two "skins" should be separated by a vapour barrier such as aluminium foil. Covering the top of the flue is a flat cap. At the base is fitted either a regulator of the butterfly type, as shown in diagram (Fig. 5), or alternatively a hinged flap. Adjusting ropes for the regulator are suspended so that their lower ends are five or six feet above floor level.

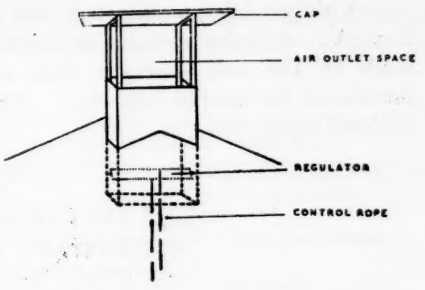


FIG 5. SIMPLE RECTANGULAR AIR OUTLET FLUE.

2. **Air Inlet Ventilators.**

As a general rule, air inlet ventilators should be placed along all the outside walls, and be so distributed that air can be admitted to all parts of the house. In order to secure even distribution of admitted air, and so that it does not enter the house at too great a velocity, a number of well-spaced ventilators are essential. These requirements are met satisfactorily be fitting one ventilator in the wall above each pig pen.

The detail of a cheaply constructed baffled and controllable inlet ventilator that has proved efficient in action is shown in Fig. 6. This is made of any good insulating material and which, therefore, has little tendency to favour condensation at its surfaces. The inlet ventilator placed within a foot or two of the eaves, and together with hopper windows fitted with gussets (or side pieces) ensures an even, draught-free ingress of air. Unfortunately, however, all the control with this model must be exercised manually, and with a view to eliminating this an intake which had an automatic "reduction" device worked by the pressure of the wind would be desirable.

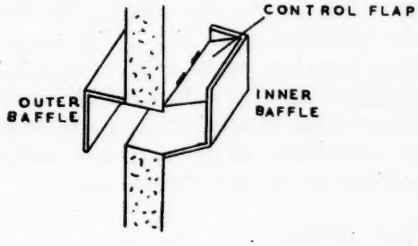
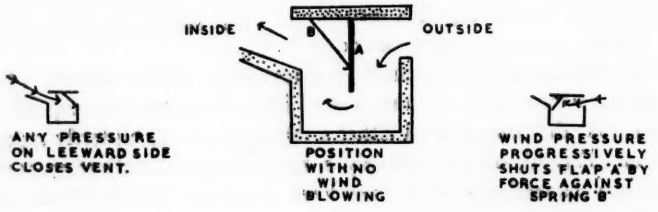


FIG. 6 A BAFFLED AIR-INLET VENTILATOR

A simple inlet of this type has been described by Wooley (1946) (see Fig. 7A). A device with similar object is the "Colt Constant Flow Ventilator," made by The Colt Ventilator, Ltd., and a form of which has recently been introduced for animal buildings. The principle by which this is worked is depicted in Fig. 7B.

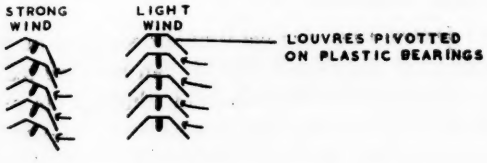
FIG 7. AIR INLETS DESIGNED FOR A CONSTANT AIR FLOW.

(A)


INSIDE
OUTSIDE
ANY PRESSURE ON LEEWARD SIDE CLOSES VENT.
POSITION WITH NO WIND BLOWING
WIND PRESSURE PROGRESSIVELY SHUTS FLAP 'A' BY FORCE AGAINST SPRING 'B'

'AUTOMATIC AIR INLET' (AFTER WOOLEY 1946)

(B)



'COLT CONSTANT FLOW VENTILATOR'

Cross-Ventilation

We found that a satisfactory measure of air flow could sometimes be maintained by using cross-ventilation alone, this being achieved by using baffled wall ventilators and hopper windows. It could only be attained, however, by very careful and constant hand control of the ventilators. The risk in this type of ventilation arises from the fact that it is too dependent on the action of the wind, a sudden increase in wind leading to draughts and over-ventilation with no one at hand; similarly, a fall in the wind speed leads to relative stagnation of air within the building. Therefore, a system independent of the wind, such as that afforded by using the insulated flue described above, is preferable always.

VENTILATION RATES

In order to calculate the dimensions of the outlet flue, it is necessary to know the ventilation rates required in a piggery. In Table II are given ventilation

rates which we have found to be satisfactory during the winter months in different types of piggeries. A subsequent communication will deal in full with this aspect of our investigations.

Usually it is advised to make total air inlet area equal to that of the outlet (Becker and Korsgaard, 1951; Kalbfleish and White, 1951; Wooley, 1946), although when adopting hopper windows as additional air inlets it is safe to provide a somewhat lesser area of effective inlet space than that for outlets. Hopper windows that can be hinged downwards flat against the wall during warm summer weather are important assets, as obviously in this way the ventilation can be greatly increased.

TABLE II SATISFACTORY AVERAGE VENTILATION RATES DURING THE MONTHS SEPTEMBER TO APRIL

Type of Piggery	Ventilation Rates Required per 200lb. Pig.
Well insulated pen with outside yard for dunging and watering.	300 cu. ft. per hour.
Well insulated totally enclosed piggery with dunging passage.	700 cu. ft. per hour.
"Deep Straw" piggery of sound construction.	800 cu. ft. per hour.

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THE MOVEMENT OF RADIO OPAQUE MATERIAL IN THE BOVINE UTERINE TRACT

By L. E. ROWSON, M.R.C.V.S.*

Introduction

INVESTIGATIONS on sperm transport in the bovine uterus were carried out by Vandemark and Moeller[1] and by Hays and Vandemark[2], who suggested that uterine motility was involved in the extremely rapid transport of spermatozoa which they were able to demonstrate. They were able to detect the presence of spermatozoa at the ovarian end of the fallopian tube within a few minutes of their deposition in the cervix, irrespective of whether the sperm were motile or dead. This uterine activity was said to occur at any stage of the cycle. Evans and Miller[3] and Cupps and Asdell[4] reported that while uterine activity was considerable at œstrus it was very much less during the luteal phase. On the other hand, Cupps and Asdell[4] also found that following oxytocin injections strong contractions occurred at any stage of the cycle.

Hays and Vandemark also showed that in the ovariectomised cow œstrogens caused a marked response to oxytocin, whereas progesterone greatly reduced the response, while in the intact animal a good response was obtained at different stages of the cycle, although the character of the contractions varied.

In contrast, Reynolds[5] [6] states that during the luteal phase the uterus is non-active and quiescent.

It is obvious from the literature that there is a considerable difference of opinion as to whether response is constant throughout the cycle or whether it is maximum at œstrus and dies away almost completely during the luteal phase of the cycle.

The work reported in this paper was not designed specifically to investigate these problems but to find out whether following ovum transplantation via the cervix, and therefore cervical stimulation causing oxytocin release, it resulted in the ova being carried through the uterus and into the fallopian tubes.

Deposition of a total of 60 ova in the uteri of two cows in the early luteal phase of the cycle and the recovery of these ova from the uteri following slaughter one and two hours later with no trace of ova in the fallopian tubes did indicate this to be unlikely, but it was decided to investigate the matter rather more thoroughly and at various stages of the cycle using, instead of ova, oil globules which were radio opaque, and therefore easily traced in the reproductive tract.

Material and Methods

The animals used in these experiments were 17 maiden heifers which had been fattened for slaughter and were in good though not overfat condition.

The heifers were run in a straw yard with a raddled and vasectomised bull to detect œstrus and were slaughtered at various stages of the œstrus cycle.

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At varying intervals prior to slaughter a quantity (usually 2 c.c.) of thin radio opaque oil (neo-hydriol*) was deposited in the body of the uterus by means of an ordinary inseminating pipette and syringe, using the rectal technique normally adopted at A.I. Centres. In cases where an injection of pitocin† was given, this was administered intramuscularly immediately following the introduction of the neo-hydriol. In most cases the animals were transported to a loosebox at the slaughterhouse and the deposition of the neo-hydriol and injection of pitocin carried out there.

In cases where the interval between injections and slaughter exceeded one hour, injections were carried out prior to the animals' removal from the farm. In those cases where the interval between instillation of neo-hydriol and slaughter

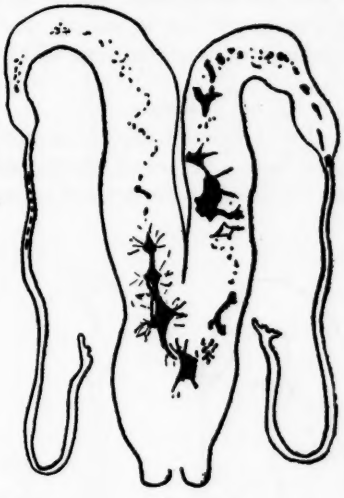

Fig. 1.
Œstrus. N.-H. 2 mins. (30 units pitocin).

was very short, the procedure was carried out with the animals in the stocks actually prepared for slaughter.

Immediately after slaughter each animal was opened up, the uterus removed and metal clamps applied to the tract to prevent further movement of the radio opaque material. The organs were then dissected to free the fallopian tubes and cornua and were placed on a photographic plate for X-ray. This technique proved extremely effective and even small traces of the radio opaque material could be readily detected.

A rather curious difficulty arose where instillation followed by pitocin injection was carried out at œstrus in that the neo-hydriol appeared to become dispersed or emulsified and to be very difficult to distinguish on the radiograph.

* Neo-Hydriol (May & Baker) Fluid is an oily liquid containing 40 per cent iodine in organic combination and is used as an X-ray contrast medium.
† Parke Davies. 10 units per c.c.

XUM

In fact much of the material seemed to have disappeared from the uterus without any detectable amounts being visible in the fallopian tubes. The plates indicated that the movement of material had, in fact, been in the direction of the tubes as none at all could be seen in the cervical portion of the uterus (Figs. 10, 11).

By shortening the interval between pitocin/neo-hydriol injections and slaughter it was possible to outline the material before the emulsifying action took place and to confirm this observation (Fig. 1).

The animals were divided into two main groups: (1) Œstrus, (2) Luteal phase.

The œstrus group were all slaughtered when the heifer was fully on heat, while the luteal group was spread out to include various stages of the luteal phase. In both groups, animals were treated with and without pitocin injections.

Results

Owing to the difficulty of reproducing radiographs showing minute traces of radio opaque material, only one actual photograph has been shown, the remainder being drawings illustrating the position to which the neo-hydriol had penetrated.

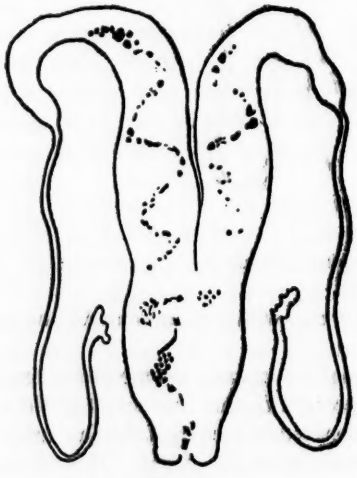

Fig. 2.
Œstrus. N.-H. 5 mins.

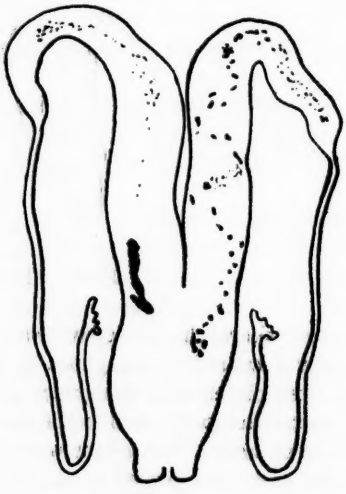

Fig. 3.
Œstrus. N.-H. 5 mins.

Results Obtained at Œstrus.

It was found that at œstrus the time taken for the radio opaque oil to reach the tip of the uterine horn was short, usually about five minutes (Figs. 2, 3), but that there was then a considerable time-lag before the material entered the fallopian tubes (probably 30 to 35 minutes). Figures 4, 5, 6 and 7 show clearly how from this time onwards there appears to be a steady movement along the

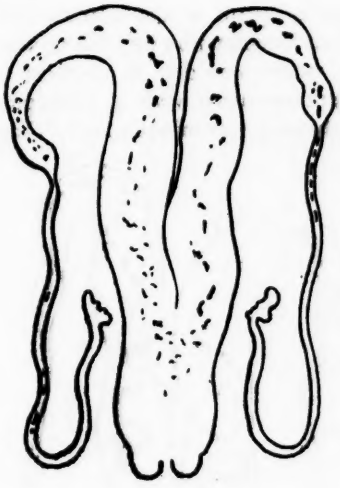

Fig. 4.
Œstrus. N.-H. 40 mins.

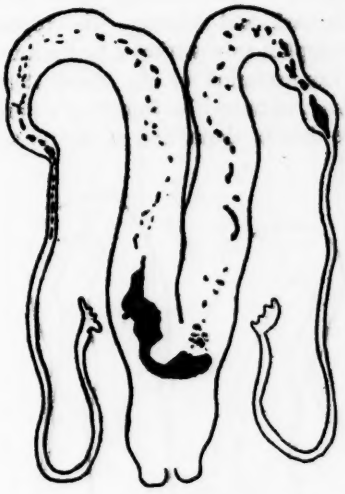

Fig. 5.
Œstrus. N.-H. 45 mins.

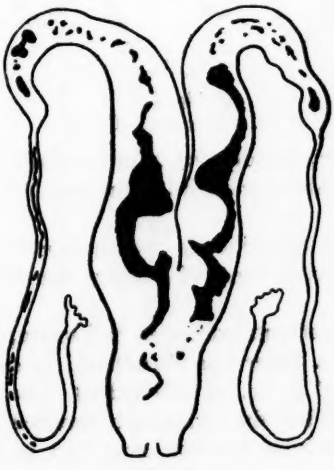

Fig. 6.
Œstrus. N.-H. 60 mins.

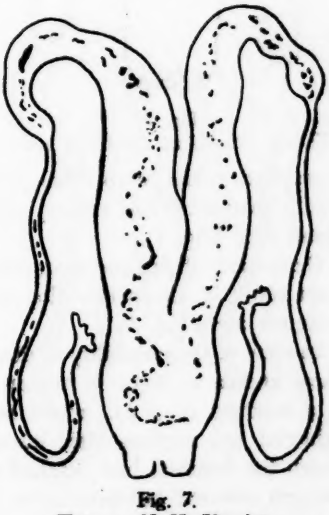

Fig. 7.
Œstrus. N.-H. 70 mins.

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fallopian tubes until the fimbria is reached at about 75 minutes from the time of deposition of the material in the tract. These findings contrast with those of Vandemark and Moeller, who reported finding sperm at the ovarian end of the fallopian tube within a few minutes of their insemination into the cervix.

Confirmation of the claim that rapid ascent was due to oxytocin was, however, obtained by injecting an animal intramuscularly with 30 units pitocin at the time of deposition of the oil and slaughtering two minutes later. Clamps

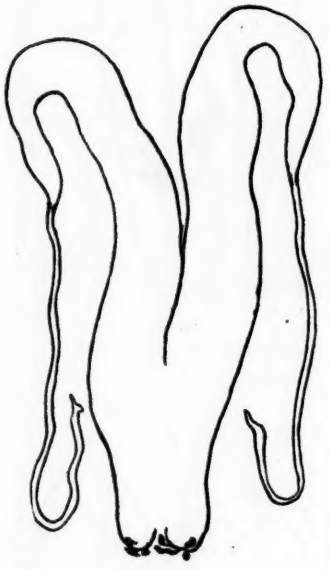

Fig. 8.
Œstrus. N.-H. at cervix 2¼ mins.

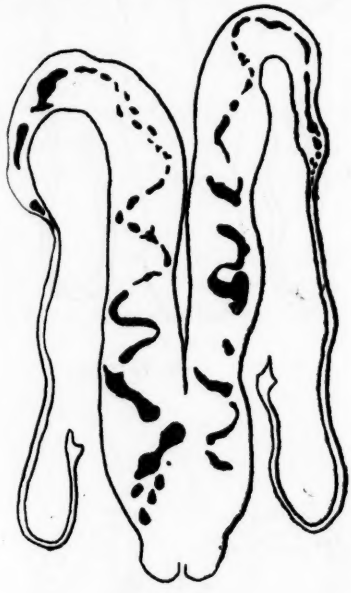

Fig. 9.
N.-H. and semen 10 mins.

were applied to the utero tubal junction very rapidly, yet X-ray revealed that the radio opaque oil had already penetrated about one third of the length of the fallopian tube (Fig. 1).

Deposition of opaque material in large quantities in the anterior vagina did not result in any penetration of the cervical canal of a heifer slaughtered 2½ minutes later (Fig. 8).

In view of the possibility of uterine contractants existing in bull sperm, such as those known to occur in human semen, a heifer was inseminated at œstrus with a mixture of 2 c.c. whole semen and 2 c.c. of neo-hydriol. She was slaughtered ten minutes after insemination, but the radiograph revealed that although the material had reached the utero tubal junction, none had, in fact, penetrated into the fallopian tubes (Fig. 9).

Results Obtained During the Luteal Phase.

Results obtained during the luteal phase contrasted sharply with those obtained during œstrus.

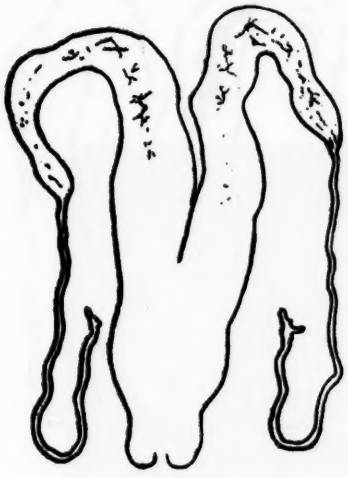

Fig. 10.
Œstrus. N.-H. 60 mins. (30 units pitocin).

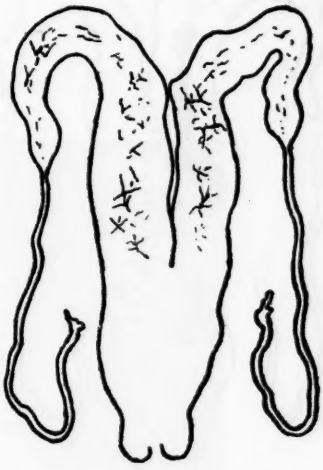

Fig. 11.
Œstrus. N.-H. 65 mins. (30 units pitocin).

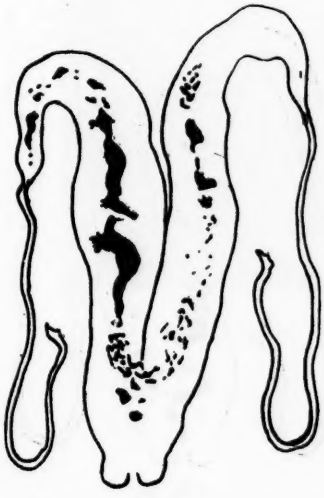

Fig. 12.
Luteal phase (12 day). N.-H. 30 mins.

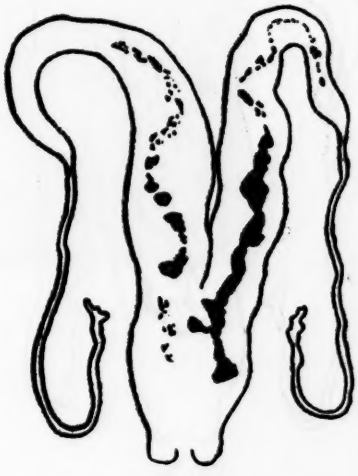

Fig. 13.
Luteal phase. N.-H. 30 mins. (30 units pitocin).

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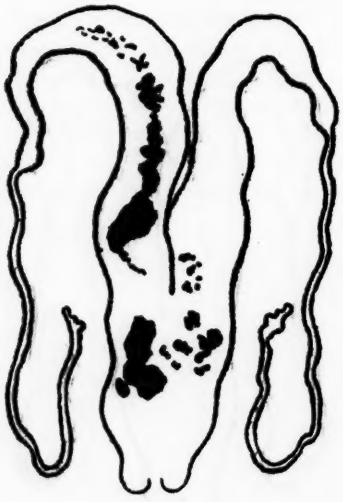

Fig. 14.
Luteal phase. N.-H. 40 mins. (50 units pitocin).

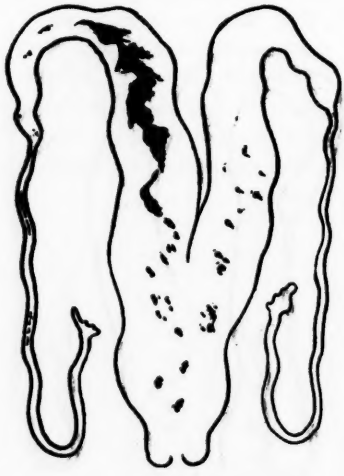

Fig. 15.
Early luteal phase (2 days). N.-H. 90 mins.

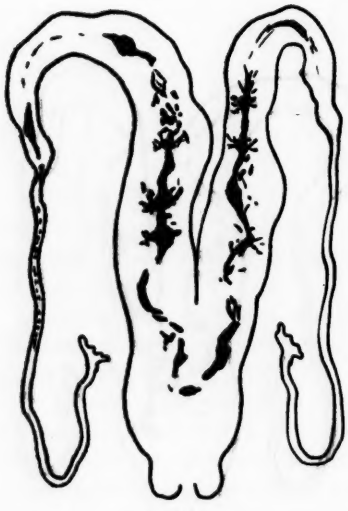

Fig. 16.
Luteal phase (1 day). N.-H. 5 mins. (30 units pitocin).

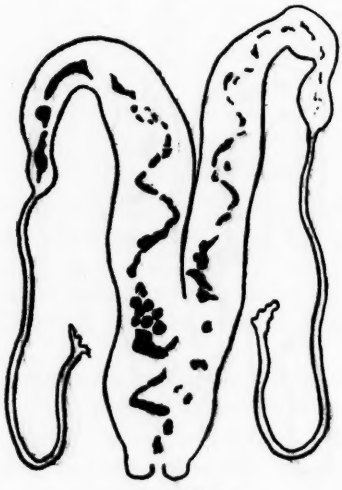

Fig. 17.
Pre-œstrus (3 days after C.L. removed). N.-H. 45 mins.

Œstrus: Uterus 60 minutes after deposition of Neo Hydriol. No pitocin.

(*Article by Rowson, page 334*)

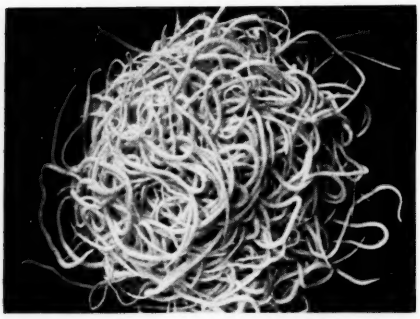

Fig. 1
1,025 adult *A. vitulorum* from seven-day-old calf.

[*Photo: I.C.I. (India) Ltd.*

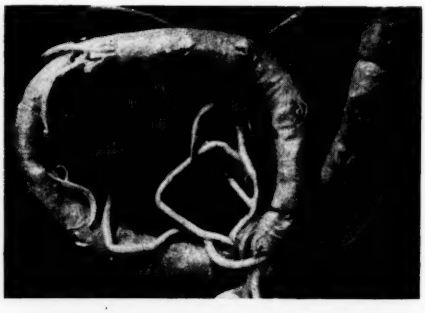

Fig. 2
Intestine impacted with adult *A. vitulorum*.

[*Photo: I.C.I. (India) Ltd.*

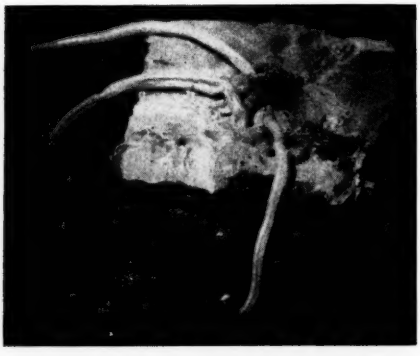

Fig. 3
Adult *A. vitulorum* in bile and hepatic ducts of 25-day-old calf.

[*Photo: Authors*

(*Article by Das, page* 342)

At mid-cycle no radio opaque material ever penetrated into the fallopian tubes, whether or not pitocin was injected (Figs. 12, 13, 14). In addition, the characteristic dispersal or emulsifying feature found at œstrus following pitocin injections was not exhibited at this stage of the cycle. In fact, it did appear that pitocin injected at this stage of the cycle had remarkably little effect. It seemed likely that this phenomenon of reduced activity and response was due to the corpus luteum and, in fact, this was supported by experiments on two animals in the very early luteal phase before the corpus luteum was fully developed.

In one of these deposition of the radio opaque oil was made two days after œstrus and at 90 minutes the material had reached a little over half way along the fallopian tube (Fig. 15). In the second animal, deposition was carried out one day after œstrus and 30 units of pitocin given. This heifer was slaughtered after five minutes and X-ray revealed the radio opaque material to have penetrated about one half of the way along the fallopian tube (Fig. 16).

In two animals radio opaque material was deposited in the uterus three days after removal of the corpus luteum, but before either heifer was showing any symptoms of œstrus. One was slaughtered at 45 minutes and penetration of the tubes had not occurred (Fig. 17). The other received 30 units of pitocin and was slaughtered at 75 minutes. In the latter case the emulsified appearance of the neo-hydriol was seen again, making the radiograph difficult to interpret.

Discussion

The results obtained in these experiments confirm the findings of Hays, Vandemark and Moeller on the following points:—

(1) Ascent of fluid in the reproductive tract is mechanical.

(2) Oxytocin injection causes a more rapid ascent.

The results, however, differ in the rapidity of ascent at œstrus without pitocin injections and are widely divergent on ascent in the luteal phase.

It would appear from these experiments that the luteal phase uterus is relatively unresponsive to oxytocin, whereas at œstrus the response is very great.

The emulsifying effect of pitocin injections on the neo-hydriol which was seen where the oil was left in the œstrus uterus for some considerable time was presumably due to the frequent contractions set up by the injections, and as this phenomenon was not seen at any other stage of the cycle it is reasonable to suspect that there is an entirely different response to the injections at this phase. In view of the fact that in animals superovulated during the luteal phase the descent of the ova down the fallopian tube is much more rapid than normal, Rowson[7], it would indeed have been surprising if the radio opaque material had penetrated the tubes in the reverse direction during this phase of the cycle. In addition, in cases of superovulation during the luteal phase no fertilisation occurs and sperm are not normally found in the zona of ova shed at this time.

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Acknowledgments

The writer wishes to express his thanks to Col. John Hickman and Mr. Devereux of the Department of Veterinary Clinical Studies for taking the radiographs and for advice on radio opaque materials. Also to Mr. Strange of the Unit of Reproductive Physiology and Biochemistry for his continuous help, and to Dr. T. Mann for help and advice.

The work was undertaken as part of the programme of study on ovum transplantation being undertaken by the A.R.C. Unit of Reproductive Physiology and Biochemistry.

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CALF ASCARIASIS IN INDIA. A NINE YEARS' SURVEY WITH SPECIAL REFERENCE TO "HETRAZAN"

By K. M. DAS, G.B.V.C.(Pat.), and G. B. SINGH, B.A., M.R.C.V.S.*

Orissa

Introduction

ALTHOUGH bacterial white scour is almost absent in Orissa, parasitic white scour, particularly due to ascariasis, is of common occurrence and, indeed, buffalo calf ascariasis is probably the greatest single factor in the heavy annual loss on our farms. It is, for some unknown reason, far more lethal to buffalo than to cattle calves. All buffalo calves born on our farms are found to be clinically infested at birth and, until recently, more than 80 per cent died despite the best available chemotherapeutic measures.

The literature dealing with ascariasis in man and animals, other than cattle, in India and elsewhere is plentiful, but that dealing with bovine ascariasis is meagre. Infestation with *Ascaris vitulorum* has often been recorded in India and less frequently in temperate climate countries. Keith (1951) recorded the first incidence of *A. vitulorum* in a calf in Australia, while Gadzhiev (1951) reported the occurrence of this parasite in 41.8 per cent of month-old buffalo calves in parts of Russia. Herlich (1953) and Casarosa (1953) studied the migration of *A. vitulorum* in calves. White (1941) described chronic interstitial hepatitis in the pig, which he attributed to migrating *Ascaris lumbricoides* larvæ, and Commeny *et al* (1946) demonstrated the localisation of this species in the human liver. Cardenas Montero (1950) observed histamine-like substances in the perienteric fluid of *A. lumbricoides* in Chile. Jacobsen (1950) demonstrated

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peritonitis due to *A. lumbricoides* in a girl, and eosinophilia was recorded by Welcker (1950).

Yutuc (1949) reported prenatal infestation of dogs by ascarids, and Sprent (1950) demonstrated toxic and allergic reactions to fluids of ascarids.

During treatment for Bancroftian filariasis with "Hetrazan" (Lederle), expulsion of ascarids was reported by Briceno Rossi and Hewitt (1949) in Puerto Cabello, Venezuela, and also by Galliard and Mille (1949) in Tahiti. The ascaricidal action of this drug was also reported by Oliver-Gonzalez *et al* (1949) in Puerto Rico, by Colbourne (1950) in the United Kingdom, and Etteldorf and Crawford (1950) in the U.S.A. Guilhon (1948) reported some anthelmintic action of phenothiazine on poultry ascarids and Korkhaus (1951) and Lazarus and Rogers (1951) reported on the ascaricidal actions of "Mandaverm" and phenothiazine. Kulinich (1951) used sodium fluoride and Riedel (1951) used "Caricide" ("Hetrazan") on poultry ascarids with success. Singh *et al* (1952) in India reported on the ascaricidal action of "Hetrazan" on *A. lumbricoides* in man. The varying ascaricidal actions of santonin, oil of chenopodium, hexylresorcinol and tetrachlorethylene have been described previously.

Susceptibility.

Our observations show that cow calves under one year and buffalo calves under six months of age are usually affected. The majority of cow calves become infested after birth, although a few cases suggestive of prenatal infestation have been observed. Repeated tests have shown no case of intestinal ascariasis in adult cows or buffaloes on our farms.

Mode of Infestation.

Methods to counter the accepted mode of infestation by ingestion such as feeding calves from a pail or cleaning the udder thoroughly before milking and muzzling the calves have failed. This, of course, raises the question of alternative invasion routes, e.g., through the unbroken skin as in ancylostomiasis. Our knowledge of the life-cycle of the parasite shows that ova need 15 to 40 days outside the host's body for the development of infective larvæ. When infective eggs are swallowed, 4 to 6 days are spent in larval migration *via* the blood stream through the liver, heart and lungs. A variable period is then spent during which the larvæ rupture the alveolar capillaries, migrate up the trachea, are swallowed, and so return to the intestine where about a month is passed in reaching sexual maturity. Thus, from the moment that the eggs are voided in the fæces, a period of 7 to 11 weeks must elapse before they can again be demonstrated in the fæces of a new host; the prepatent period is shorter, being 34 to 36 days.

We believe that the majority of buffalo calves are infested placentally. Not only have calves, seven days old, shown *Ascaris* ova in their fæces, but one seven days old calf had, at examination post-mortem, 1,025 adult ascarids in the intestine (see Fig. 1). So far, no ova have been detected in calves older than one year and intestinal infestation with adult ascarids has never been seen in adult animals, although it is presumed that larval ascariasis may be present.

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Diagnosis

We find that the routine methods of fæcal examination for the presence of eggs give positive results which are too late for the adoption of chemotherapeutic measures since a heavy infestation is present when ova are seen. Clinical signs must therefore be relied upon and these include loss of glossiness and skin tone, with eczema, offensive stools resembling white scour, inappetance, intermittent colic and tympany, and occasional dysentery. Despite a negative microscopical finding, these signs are strongly indicative of ascariasis. In the early stages of infestation, unfertilised atypical ova only are seen. Rarely seen are "fits" with the following signs: an apparently healthy animal falls, showing anaphylaxis-like signs such as champing of the jaws, shivering, hurried respiration, accelerated pulse, frothing at the mouth, "paddling," opisthotonus and collapse in a few minutes. Only one such case has survived.

Microscopical Examination of Fæces.

Direct methods detect all cases of moderate infestation, but very light infestations may be missed. A saturated solution of zinc sulphate or sodium chloride is suitable, although, in our experience, an aqueous sugar solution (1,280 gm. per litre) is best.

Appearances Post-Mortem

The lungs are often involved and show different stages of pneumonia. The occurrence of peritoneal, pleural and pericardial fluid is common. Often the intestine resembles an elongated sausage as it is packed with ascarids in varying conditions of maturity (see Fig. 2). Hæmorrhagic enteritis, sometimes general, with occasional necrosis has also been seen. In most cases treated with 1 :8 dihydroxyanthraquinone as an adjunct to tetrachlorethylene, generalised enteritis has been noted but could not be ascribed specifically to chemical action or to ascarotoxicity from dead parasites.

Parasites have also been seen in unusual sites (see Fig. 3). Live adults have been observed on many occasions in the biliary passages and on other occasions migration by the worms into the abomasum has been seen. Perforating peritonitis has not been noticed by us. Similar migration by *A. lumbricoides* into the liver, causing cirrhosis, and stomach of man and the pig and by *Toxacaris* species in the dog have been described.

Immunity.

It is presumed that infestation confers immunity since reinfestation has not been observed in any case.

Toxin Production.

It is held that dead ascarids liberate the powerful toxin ascaridon (ascarotoxin) which may be lethal, and our experience corroborates this. Ascarids also liberate certain histamine-like substances through their tissue fluids and cause allergy as described by Sprent (1950) in man and the pig. The clinical "fits" observed may result from such toxic products.

Chemotherapeutic Measures.

1. *Tetrachlorethylene B.P. followed by magnesium sulphate.*

Before medication, calves were maintained on a fat-free diet for three days and this was followed by fasting for 24 hours. Treatment consisted of drenching through a funnel and tube with 10 c.c. of a 1 per cent copper sulphate solution, which was immediately followed with tetrachlorethylene (1 c.c. per 10 lb. body weight) emulsified in rice gruel. Magnesium sulphate solution was given in like manner two hours afterwards. The dose of tetrachlorethylene varied from 8 c.c. to 15 c.c. Of 46 calves treated, 43 died and 3 recovered, giving a mortality of 93·5 per cent.

2. *Tetrachlorethylene B.P. followed by 1:8 dihydroxyanthraquinone.*

Medication was the same as the above, except that the magnesium sulphate was replaced by 1 :8 dihydroxyanthraquinone in doses of 2 to 5 gm. dissolved in two pints of warm water and given in two parts, the first being given two hours after the tetrachlorethylene and the second 12 hours later, if necessary. The 43 calves that were treated all died.

3. *Tetrachlorethylene B.P. combined with liquid paraffin.*

Medication was similar to Method 1, except that the tetrachlorethylene was emulsified in four parts of liquid paraffin and no subsequent purgative was given. Of 33 calves treated, 28 died and 5 recovered, giving a mortality of 85 per cent.

4. *Combined doses of santonin, oil of chenopodium, oil of turpentine and castor oil.*

All were given without subsequent purgatives. Three calves were treated and all died.

5. *Combined doses of oil of chenopodium, oil of turpentine, creosote and castor oil.*

Eleven calves were treated and all died.

6. *"Gajapepla" (Scandipsus indica).*

The pod of this indigenous plant is used by buffalo breeders for the treatment of calves; it measures about 3 in. by 1½ in. in diameter and contains thorny bristles which are emulsified by boiling in water. The semi-solid mass obtained from two to six pods is drenched in milk or whey according to size. Three calves drenched in this manner passed a few dead worms and died after a few days.

7. *"Hetrazan" (Lederle).*

"Hetrazan" is 1-diethylcarbamyl-4-methyl-piperazine dihydrogen citrate and, as far as we know, this compound has not previously been used for ascariasis in calves. It has, however, been used for ascariasis in man, pig and dog with considerable success. It was given in doses of 6 to 12 mg. per kg. body weight thrice daily in electuary for 5 to 7 days, depending on the condition of the animal. Although subsequent purgation is not advised for man, in our experience half doses of magnesium sulphate repeated on the last two days of treatment is of added advantage in calves. Of 51 calves treated all but two recovered, giving a mortality of 4 per cent. Animals having a fæcal egg-count of 420,000 per gm.

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ceased to show eggs in the fæces in the course of one to two weeks from the start of treatment, except in the case of the two calves which died later in convulsion. In the surviving animals, from 12 to 208 dead adult worms were passed within a month of the first dose.

Discussion

Although tetrachlorethylene kills ascarids, it is thought that the loss of bowel tone, incident to the infestation, retards response to purgatives and so allows varying degrees of ascarotoxicity. The evidence of prenatal infestation suggested the use of larvicides, such as " Hetrazan " (Lederle), in the pregnant dam because of its known efficacy on Bancroftian larvæ (Briceno Rossi and Hewitt, 1949) and on *Setaria cervi* larvæ (Shoho, 1952) in body tissues.

In Orissa in the adult buffalo liver cirrhosis, characterised by anorexia, intermittent diarrhœa, gradual loss of condition and a varying degree of ascites is a common cause of death in two to three months. It has been rampant for the past few years. It has, however, shown a tendency to a reduction in incidence corresponding to the decline in ascariasis. Is it possible that the two conditions may have a common ætiology?

Summary

Observations on different aspects of ascariasis in cow and buffalo calves in Orissa have been made over a period of nine years. These included 168 examinations post-mortem and 197 treatments with the following: tetrachlorethylene and magnesium sulphate, tetrachlorethylene and 1 :8 dihydroxyanthraquinone, tetrachlorethylene and liquid paraffin, pods of *Scandipsus indica* and " Hetrazan," the last-named giving the best (96 per cent success) results. Trials with toluene, hexylresorcinol and 6-tertiary-butyl-*m*-cresol are envisaged. Widespread prenatal infestation in buffalo calves has been observed, although dams have not shown clinical intestinal ascariasis.

Acknowledgment

We wish to thank the Veterinary Service Department of Imperial Chemical Industries (India) Ltd. for the photographs comprising Figures 1 and 2, for the supply of various trial materials, and for technical advice from time to time.

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SEX DETERMINATION FROM THE EXAMINATION OF THE INNOMINATE BONE IN THE DOG

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Material

THE innominate bones of 70 cross-bred, adult dogs were used. They were from animals of similar size and type and the sexes were equal in number.

The method of analysis of variance (Snedecor, 1946) was applied to test the significance of the numerical results occurring between the two sexes.

Results and Discussion

The innominate bone presents prominent characteristic features on which determination of sex can be easily and precisely attained.

A significant difference was noted when measurements of the principal diameters of the pelvis in both sexes were compared. In the female the average transverse and conjugate diameters were 50.75 mm. and 55.09 mm. respectively, with a ratio of 0.920, while in the male averages were 47.37 mm. and 58.43 mm. with a ratio of 0.813.

These results indicate that the female pelvic inlet is more circular than that of the male.

Also by measuring the breadth of the floor and considering its relation to the length of the lateral wall of the pelvis, it was found to be 0.717 in the female and 0.656 in the male.

This shows that the pelvis in the female has a greater capacity than that of the male.

TABLE I

The Averages and Standard Deviations of some Measurements of the Innominate Bones and their Ratios in both sexes

	Male			Female		
	No. of Cases	Average	Standard Deviation	No. of Cases	Average	Standard Deviation
Length of lateral wall	35	141.20 mm.	±9.5	35	123.40 mm.	±10.00
Breadth of floor	35	93.20 mm.	±7.52	35	88.57 mm.	± 7.81
Ratio of breadth to length ...	35	0.656	±0.0142	35	0.717	± 0.0117
Transverse diam. of inlet ...	35	47.37 mm.	±3.16	35	50.57 mm.	± 2.94
Conjugate diam. of inlet ...	35	58.43 mm.	±3.87	35	55.02 mm.	± 3.78
Ratio of transverse to conjugate	35	0.813	±0.0401	35	0.920	± 0.0441
Depth of ischial arch	35	19.89 mm.	±1.88	35	14.40 mm.	± 2.34
Width of ischial rach	35	39.49 mm.	±3.96	35	44.43 mm.	± 6.60
Ratio of depth to width ...	35	0.504	±0.0172	35	0.347	± 0.0325

In addition to the previously mentioned features, it was noted that the ischial arch in the male was much deeper than in the female. The average depths of the ischial arches were 19.89 mm. and 14.40 mm. in the male and female respectively. The width of the ischial arch was greater in the female than in the male. Their average breadths were 44.43 mm. and 39.49 mm. respectively. The ischial arch in the male is deep and narrow, while that of the female is shallow and wide.

Considering the bony pelvis as a whole, the female one is lighter in construction, the muscular impressions are not as well marked and it is of greater capacity. In the male, the crest of the ilium is more prominent and convex than in

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the female. Likewise, the ileopectineal line is sharp, while in the female it is somewhat rounded. The female obturator foramen has a triangular appearance with rounded angles and in the male it has an oval outline. In the female the transverse diameter of the acetabulum is greater than the longitudinal diameter. The diameters of the male acetabulum are almost equal.

Most of the above differential features can be used for sex determination in the horse (Sisson and Grossman, 1948; and McFadyean, 1922) and in humans (Heyns, 1947; Johnston and Whillis, 1946; Sidney Smith, 1936; and Cadwell and Maloy, 1932).

TABLE II

Macroscopic Aids to Sex Differentation

Part	Male Innominate Bone	Female Innominate Bone
As a whole ...	Heavy and of small capacity	Light in construction and of great capacity
Inlet ...	Oval	Almost circular
Ischial arch	Deep and narrow	Shallow and wide
Ischial angle	Narrow	Wide
Iliac crest ...	Prominent	Not prominent
Ileopectineal line	Sharp	Somewhat rounded
Obturator foramen ...	Oval	Triangular with rounded angles
Acetabulum	Almost circular	Oval

Acknowledgment

I am indebted to Professor Mohamed Emara, Faculty of Medicine, Cairo, for his guidance in this study.

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ABSTRACT OF LITERATURE

SOME OBSERVATIONS ON CANINE SEMEN, by A. E. Harrop, *Veterinary Record*, 67, 495. June 25, 1955.

USING an artificial vagina (method described in *The British Veterinary Journal*, May, 1954), Harrop made over one hundred collections of canine semen from different breeds. Average volume was 9.5 ml. and he confirms that each collection tends to come in three fractions. A detailed examination has been made of the contents of each fraction and the time involved in ejaculation which shows: fraction one is probably a lubricant, time 30 to 40 seconds; fraction two is sperm-containing, time 50 to 80 seconds; while fraction three takes from 3 to 30 minutes and is described as the prostatic secretion and the medium in which the spermatozoa travel up to site of fertilisation, and this third fraction increases the motility of the second. Author stresses the danger that sterility may be wrongly assumed due to inexperienced mating. Other findings as to density, pH and the effects of frequent ejaculation are given and discussed.

REVIEWS

TEXT BOOK OF SPECIAL SURGERY, by E. Silbersiepe and E. Berge, 12th Ed., 1954, with 556 illustrations. 595 + 16 pages. Stuttgart: Ferdinand Enke.

THE text of this book follows a similar pattern to the previous edition with the major emphasis still on the larger domestic animals. The increase in the size of the book by 43 pages is caused principally by the addition of over 90 new illustrations. Glancing through the pages one cannot help but get the impression that for some reason or other the German veterinary surgeon has not kept abreast of modern therapeutical measures and surgical enterprise. The complete absence of references to current literature, in all probability, is one explanation. The other, no doubt, is the sequel to a war which has divided the country and virtually imprisoned its inhabitants.

The illustrations of disease processes are excellent but many of them depict lesions of such a gross nature that would not be allowed to develop to such a degree in this country. The text is amply descriptive of the subject throughout but there is a noticeable lack of surgical technique and operative detail. Modern methods of anæsthesia are conspicuous by their absence. Current methods of treating fractures receive scant attention. This was at one time a sound text book. It could be so to-day if it were brought up to date. The publishers have fulfilled their task admirably.

XUM

BREAD, by Lord Horder, Sir C. Dodds and T. Moran, 1954. 186 pp. London: Constable & Co. Price 18s.

As men, veterinary surgeons have as great an interest in bread as any of their fellow human beings: as exponents of an art and a science, they are amongst

> " that section of the public which possesses a scientific background—a section which includes the doctor, the science teacher, the social worker and the dietician "

to which the authors primarily present their book: as the guardians of millions of animals they are concerned with a food which, directly or indirectly, has vital links with many of those creatures.

The eminence of its authors is no guarantee that a particular book will be well written or comprehensive, whilst, all too often, a volume written by several men will prove inferior to the singleness of mind and of viewpoint portrayed by one individual. In both respects, however, the present subject of review may honestly be said to be satisfactory. For one thing, though the respective interests of the three collaborators would seem to be both different and well defined, there are no marked stylistic differences in the texture of the various chapters: the book has unity. It possesses also a sanity of outlook and of treatment which is not only reassuring to its readers but might well be a model for other texts.

In chapter 1 (13 pp.) the history of bread is described briefly. In passing, it may be said that the contrast between Fig. 4 (Tower windmill) and Fig. 5 (modern flour mill) should make the reader think not only of milling, but also of the disturbing complexity of the structure of modern society: in our century we do good or evil on a gigantic scale. Some 10 pages are then used to describe the general nature and distribution of the wheats of the world, whilst chapter 3 (42 pp.) gives a very full account of the chemistry of wheat, flour and bread. In chapter 4 (16 pp.) there is a short description of the technical aspects of milling and baking, followed (chapter 5, 17 pp.) by an account of those " improving agents " (including " agene "), which are used to " improve " the quality of bread. This last chapter has obvious biological implications for both man and his beasts, inplications which are discussed in scientific breadth as well as historic depth: this is definitely a section for veterinary surgeons both as individuals and as professional men. So, too, are chapter 6 (32 pp.), which discusses the digestion and assimilation of bread, and chapter 7 (20 pp.), where the nutrients of bread are dealt with. In the penultimate chapter (16 pp), the interest is predominantly human, since it describes the attempts which have been made to make bread a more complete food: this, also, is largely true of chapter 9 (12 pp.), dealing with bread and (human) health, largely socialogically.

About 300 up-to-date references are provided (at the ends of the chapters) which thus makes the volume a useful, though admittedly not comprehensive, source-book. The index lists some 500 items, but from a veterinary point of view it suffers from a complete lack of direct references to animal species. This is a pity because it does an injustice to a book of quite wide appeal.

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SQUIRRELS, by Monica Shorten. A new naturalist special volume, xii + 212 pp. 32 black and white photographs, 22 maps and drawings. 1954. London: Collins. Price 15s.

IN our childhood days many of us must have derived enormous pleasure from the adventures of that little, fat, comfortable grey squirrel called Timothy Tiptoes as recounted by Beatrix Potter who, at the beginning of her "Tale," tells us it is "for many unknown little friends, including Monica." Now that we have become men and "put away childish things" we can, whether we be aged seventeen or seventy, find similar pleasure from Monica Shorten's "Squirrels." Here is a scholarly and authoritative, yet very readable book that will interest not only the amateur naturalist but also the serious student of natural history. Because Miss Shorten has studied squirrels in their natural surroundings and in the laboratory, has bred them and kept them as pets, and has made pies of them, and even served second helpings to her most conservative friends, there is no doubt that she understands intimately her subject. She has steered a safe course between the Scylla of academic jargon and specialisation and the Charybdis of over-popular writing. After the introduction, chapter 2 deals with the classification of the rodentia from which we learn that the red squirrel in Britain is *Sciurus vulgaris leucourus* and the grey squirrel population of this country possibly represents the merging of colonies of *Sciurus carolinensis coralinensis* and *S. c. leucotis* introduced from various parts of America and Canada. Chapters 3 and 4 deal with the general characteristics of the red and grey squirrel respectively and chapters 5 and 6 with the history in Britain to 1945 of the red and grey squirrel. In the succeeding chapters information is given on the present distribution of both species, their activity, the breeding of the Grey squirrel, its development and coat, the relationship between squirrels and trees and between the Red and Grey varieties. The last Chapter is on human control. A pleasing inclusion is a two-page glossary of certain technical terms that help the layman to a better understanding of the textual matter. There is a bibliography of just over 100 references and an adequate index. The photographs illustrating the text are exceptionally fine. This book is well up to the high standard of the New Naturalist Special Volume series and is pleasantly free from errors and misprints, although *retortæformis* and *tæniæformis* are mis-spelt on pages 31 and 181 respectively. Whether the reader looks upon the squirrel as charming and interesting or as a thorough nuisance with unspeakable habits, he will nevertheless learn a great deal from this book about its economics, food, life history and ecology.

ALLGEMEINE PATHOLOGIE FUR TIERARZTE, by W. Frei. 1954. 4th Edition. 352 pp., 120 figs., 2 in colour. Berlin: Paul Parey. Price 52s. 6d. (approx.).

THROUGHOUT his course of studies, and perhaps most obviously when concerned with pathology, the veterinary student is faced with a two-fold task, the magnitude of which must not be underestimated, either by the student himself or by his teachers and examiners: first is the understanding of general principles, and second the mastering of a large and what at times must seem an over-

whelming number of ineluctable facts in the special or systematic parts of his subject. There is some debate amongst teachers as to the relative weight that should be placed on " general principles " and on " brute facts," and it sometimes turns on the question whether veterinary education can (as the reviewer believes) be properly considered an academic discipline in a university sense, or merely a technological one. Neither can be neglected: the man who does not understand the general principles of his subject can hardly claim to be an efficient technician, whereas the man who has a grasp of general principles only may be in a position of learning by experience, but in the process serious and avoidable blunders may be made.

The student who can read German will find in this excellent textbook a clear and orderly account of general pathology. There has recently been published in England a masterly " Introduction to Pathology," but that book is designed for medical students, and this work by Frei and his collaborators—Professors Dobberstein, Hemmert-Halswick and Hjärre—will be found to supply many of the needs of the veterinary student as it is rich in examples drawn from veterinary experience. The book itself is well produced, of a handy size, clearly printed on good paper, and contains a number of useful illustrations (there are 120 text figures and two colour plates). One could wish for more of these, and particularly of photomicrographs. The style is lucid, the subject matter well arranged, and the points made should be readily understood and remembered. There are three main divisions: first, a general consideration of the causal agents and factors in disease—constitution, heredity, nutrition, and physical, chemical and parasitic agents; then there is a survey of general morbid pathological anatomy and histology, including degenerations, circulatory disturbances, inflammation, repair, neoplasia, and so on; and lastly some hundred pages are devoted to an interesting consideration of pathological physiology which covers subjects such as fever, immunity, shock, functional disturbances of organs and systems, and death.

The book has been written with the needs of the practical veterinary surgeon in mind and, while some minor criticisms could, of course, be made, the only major suggestion that the reviewer would offer is that references to the literature should be given; a number of names of workers appears in the text unsupported by references. The book is very interesting and could be read profitably at three different points in a veterinary surgeon's career—when he is just starting to learn pathology, when he is nearing his final examination, and after he has some years' experience of practice; he will then be in a position to appreciate fully the general principles adequately linked with his wider knowledge of special instances.

PATHOLOGY OF THE DOG AND CAT. The Genito-urinary system with clinical considerations, by Frank Bloom, D.V.M. Pp. 463, 312 illustrations. 1954. Illinois: American Veterinary Publications Inc. Price £5.

DR. BLOOM has crystallised the results of more than 25 years' observation and detailed study of diseases of dogs and cats in this superlative account of

the pathology of the conditions affecting these species. Although confined in its contents to the genito-urinary systems together with their accessory organs, the book deals in useful detail with the rare as well as the common conditions.

In view of the obvious importance of anatomical and physiological considerations, the author has enhanced the undoubted value of the book by correlating the pathological anatomy with functions as represented by symptoms. The book is divided into three large sections covering the urinary system, the male genital system and the female genital system respectively.

The general subject matter is presented primarily under the heading of each organ and divided into groups dealing in turn with normal anatomy, including histology, congenital anomalies, circulatory disturbances, trauma, tumours, parasitic diseases and various other pathological changes. Each condition is considered further under the sub-headings of Pathological Anatomy, Incidence, Ætiological Factors and Clinical Correlation. Both sexes of the dog and cat are catered for in adequate fashion.

The author has appended at the end of each chapter an extensive and valuable list of references to American, British, German and other scientific literature. The photographic illustrations are reproduced exceptionally well; the quality of the printing and binding is of a high standard.

This book is an unique and desirable advance towards specialisation in veterinary textbooks and should prove of considerable value to the veterinary pathologist and clinician and to the many other persons who delve in the biological field.

AN OUTLINE OF THE INFECTIOUS DISEASES OF POULTRY, by Frank H. Manley, D.V.M., M.V.Sc., M.R.C.V.S. Minnesota: Burgess Publishing Co. Price $2.25.

THIS book comprises part of the lecture material used by Professor Manley in a course on poultry diseases for veterinary students at the School of Veterinary Medicine, Alabama Polytechnic Institute. The subject matter is presented in synopsis form and covers the more important infectious diseases of poultry only. There has been no attempt to include anything but the salient features of each condition and consideration is given largely to the problems which are of special interest to American workers.

The classification of diseases is divided into four groups, viz., bacterial diseases, viral diseases, diseases caused by fungi and one disease of undetermined ætiology. The omission of parasitic conditions and problems associated with nutrition and husbandry detracts from the value of the book. Students in the United Kingdom may not agree that anthrax, brucellosis, paracolon infection, staphylococcosis, streptococcosis and tetanus should be included among the more important diseases of poultry; on the other hand, they will find useful summaries of some of the well-known conditions found in this country. Possibly the most

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valuable aspect of the book is the inclusion of material based on the author's own observations.

There are no illustrations and lists of references have also been omitted. The printing has been carried out by duplication on one side only of thick absorbent paper, the perforated sheets being held between the paper covers by spiral spring binding.

It is Professor Manley's declared intention that the outline will be of help to those who wish to obtain the main facts concerning each disease without consulting textbooks or scientific literature. The over-concise presentation, the omissions and the lack of application to British problems, however, render the book of limited value to students of poultry diseases in this country.

GAIGER AND DAVIES, VETERINARY PATHOLOGY AND BACTERIOLOGY, by G. O. Davies. Fourth edition. Pp. VIII + 804. London: Baillière, Tindall and Cox. Price 42s.

FOR many years now "Gaiger and Davies" has been the favourite and valued textbook for veterinary students during their pathology course, and has become something of a students' classic. It is sad to reflect that this edition is probably the last we shall see in the present familiar form. Dr. Davies writes in the preface that he is engaged on the major task of rewriting and recasting the whole book, so that here we have what might be considered to be an interim edition, the purpose of which is to bring the existing text material up to date. The present may thus perhaps be a suitable time to attempt to evaluate the book as it stands now, bearing in mind that any criticisms made may be nullified when the projected new work appears.

The book itself is an excellent one from the point of view of size, printing and lay-out, and the style is generally clear and pleasantly didactic. The photographs are not infrequently too small in size and sometimes too low in magnification; the publishers no doubt have always to consider costs, but an increase in price would be justified if there were a sufficient number of photographs of adequate size and magnification.

What is perhaps the most important criticism that may be advanced is that the original authors were at fault (and the fault is admittedly a generous one) in trying to encompass the subjects of "pathology" (including morbid anatomy and histopathology) and "bacteriology" (including also virology and protozoology) within the covers of one book of handy size. They were on the whole very successful in the field of "bacteriology." Dr. Davies has maintained that success, but the treatment of "pathology" was not detailed enough to meet the needs of the veterinary student and practising veterinary surgeon. If it be not impertinent to proffer advice, it might be suggested that the time has come for the book to be split into two parts so as to deal with "pathology" and "bacteriology" separately. Veterinary morbid anatomy and histopathology are acquiring a considerable literature, and are of such importance that they deserve a more extended treatment.

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The profession owes a great debt to Dr. Davies for the conscientious way in which he has carried out an onerous and time-consuming task and we shall look forward with great interest to seeing the result of his new endeavour. Meanwhile it will suffice to draw our readers' attention to this new edition of an old and useful friend.

NOTICES

IMPERIAL CHEMICAL (PHARMACEUTICALS) LTD. have introduced "Siopel" cream, a skin protective for veterinary use, incorporating a silicone fluid. They state it is non-greasy, non-irritant and water-repellent and amongst recommended uses are: (*a*) as a barrier cream when making rectal examinations and obstetrical manipulations; (*b*) for prevention of inflammation and excoriation of skin around the wound after surgery; and (*c*) for protection from chronic dermatoses amongst veterinary workers sensitive to antibiotics, drugs and allergens. It is issued in packs of 50 and 500 grammes.

ALLEN & HANBURYS LTD. announce the introduction of Procaine Penicillin Intramammary Injection, which has a new base designed to give a prolonged concentration of penicillin in the udder. It is packed in tubes containing 100,000 units of penicillin G. This firm also state that prices of their Veterinary Alficetyn preparations have been reduced.

NEXT ISSUE — CONGRESS NUMBER

Copies of September THE BRITISH VETERINARY JOURNAL will be available on Stand 6 at the B.V.A. Congress Exhibition in Belfast, Sept. 5-10.

Publishers' Notices

THE BRITISH VETERINARY JOURNAL, with which is incorporated THE VETERINARY JOURNAL, is published monthly, and copy for advertisements should be in the hands of the advertisement manager not later than the 20th of the preceding month, if proof is required. Tel.: Temple Bar 3386.

Letters for the Journal, literary contributions, reports, notices, books for review, exchanges, new instruments or materials, and all matter for publication (except advertisements) should be addressed to the Editor.

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